



Sludge Mass Estimation and Reduction, Aluminum Dissolution - Update

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WSRC
Sludge and Salt Planning

Background

- DWPF feed batch sludge mass seemed to be under predicted but extent and causes were unknown
- Uncertainty in sludge mass estimates identified as a “key vulnerability” in risk assessment
- Risk Handling Strategy included “determine if WCS is adequate for sludge and salt processing”
- Sludge Mass Review team formed in Fall of 2005

Sludge Mass Review Team

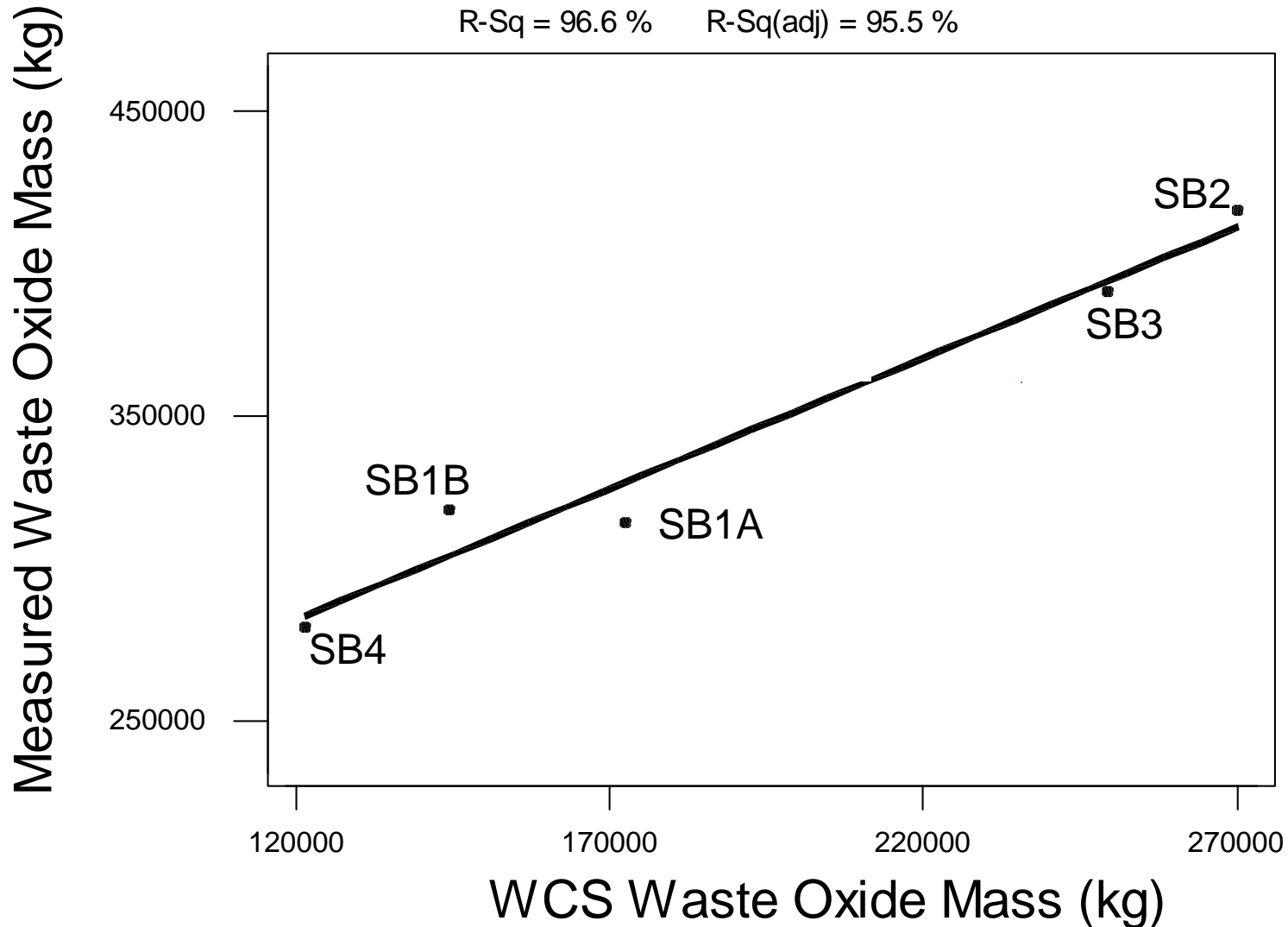
- Tank Farm Operations Support
- Tank Farm Technical Support (Historical and current)
- Sludge composition model development and application
- Canyon Process Chemistry
- DWPF Feed Batch Planning historical approach
- SRNL Sludge Characterization experts
- Independent reviewers

DWPF Sludge Batch Estimates – Predicted vs. Measured

Batch	Predicted WCS Sludge 1.5 Model (kg calcine)	Observed DWPF Sludge Batch Characterization (kg calcine)	Percent
SB1A	173,000	315,000	182%
SB1B	144,000	319,000	221%
SB2	270,000	417,000	154%
SB3	249,000	391,000	157%
SB4	121,000	281,000	232%

Note: Calcine refers to sludge that has been heated to high temperature to convert all compounds to oxides. This reduces error in the estimates caused by mass changes as hydration waters evaporate.

Predicted (WCS) vs. Measured Waste Oxide Mass (SB1a–SB4)



Causes

- Estimates are based on canyon flowsheets that are known to be low (conservative) for purpose developed
- Canyons often ran above flowsheet
- Method doesn't account for rework
- Method doesn't account for aluminum from different assemblies

Team Conclusions

Current sludge characterization model significantly underestimates the bulk mass of material in the tanks when compared to results from waste removal and DWPF batch characterization.

Current sludge characterization Model 'As-Is' is not suitable as a planning basis for DWPF feed mass.

An improved sludge characterization model or method is required to support DWPF feed planning.

Model Improvement Method

1. For each waste tank with data, determine the mass of Al, Fe, Mn, Ni predicted using settled sludge data combined with historical sludge volume (with density estimate).
2. Determine the mass predicted for the tank using the canyon discharge model.
3. Determine the ratio of the two numbers.
4. Group the tanks by major waste stream.
5. Select a low, moderate, and high value based on the range of values calculated.
6. Use the ratio to scale up the predictions .

- Improves canyon discharge model
- Uses information based on settled sludge measurements
- Uses more realistic settled sludge density
- Uses sludge batch information

Advantages

- Provides mass estimate closer to observed
- Can be adjusted as new information becomes available

Disadvantages

- May over or under estimate individual tank contents
- Model is not fine tuned

Independent Review Team

Areas of Expertise

Hanford system plan development

Hanford waste characterization

Hanford waste qualification laboratory

Hanford and SRS waste management programs

SRS sludge characterization and processing

Statistical methods and systems thinking

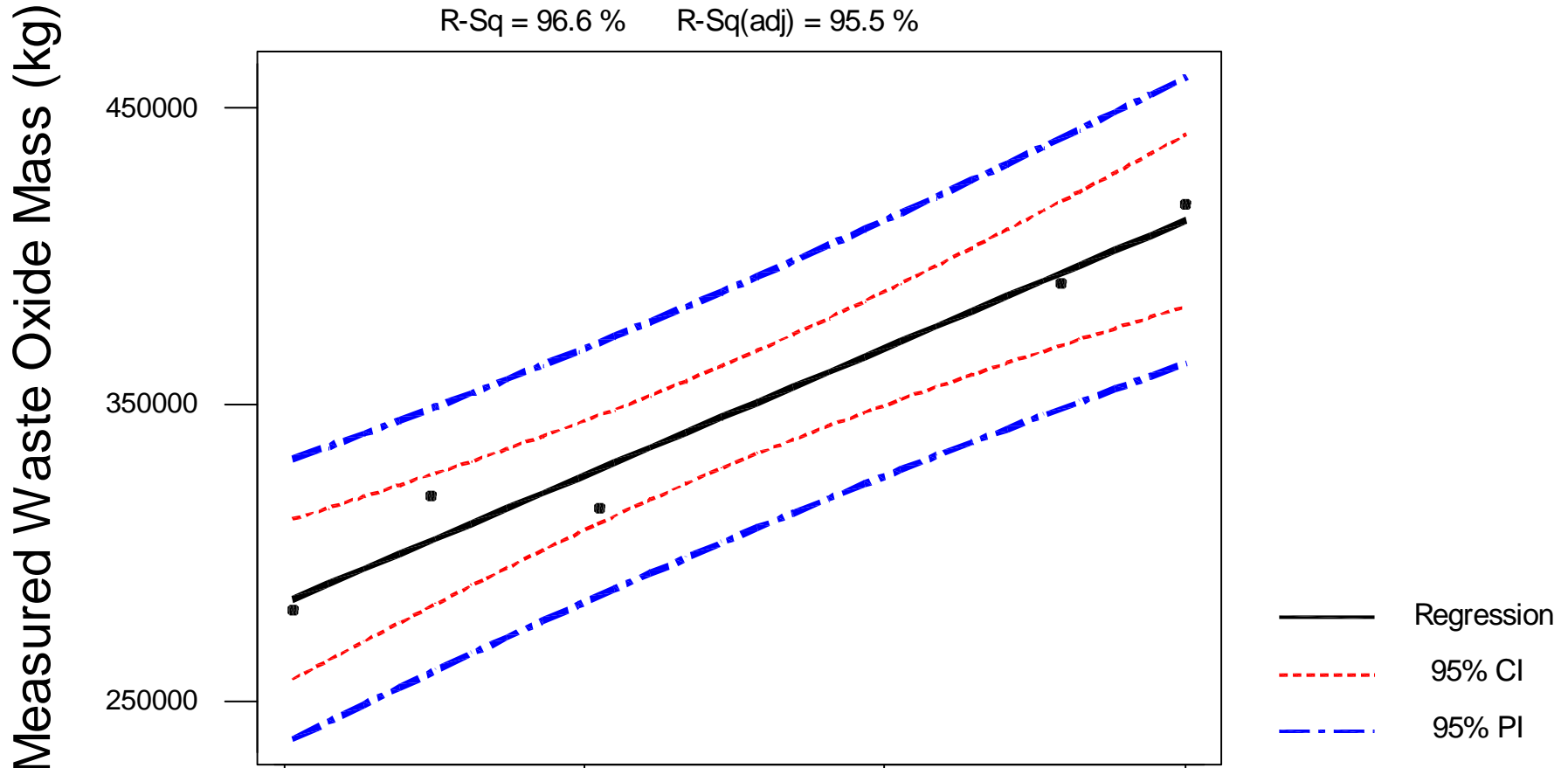
Analysis of Implications of Increased Mass

- Perform statistical analysis of uncertainty.
- Determine range of projected number of canisters.
- Determine range of years of operation.
- Determine what can be done to moderate impact.

Statistical Evaluation of Uncertainty

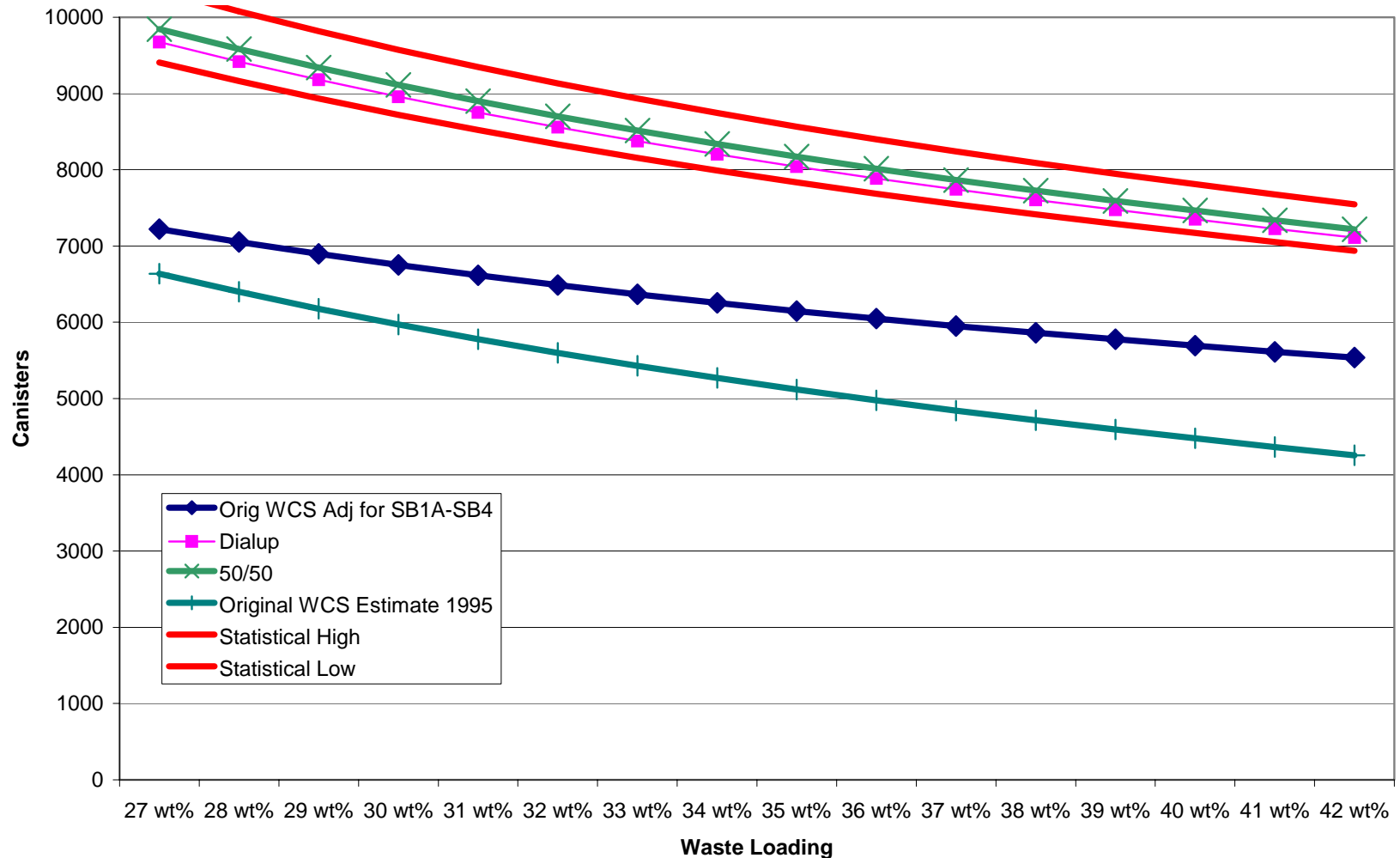
- Utilizing SRNL's Statistical Consulting Group
- Identified relationship between predicted and measured masses for first 5 sludge batches

Predicted (WCS) vs. Measured Waste Oxide Mass (SB1a-SB4)



WCS does not accurately predict sludge batch mass but has displayed a consistent bias in its predictions

Total Canisters vs Waste Loading



Path Forward for Sludge Mass Issue

Define Mitigation Schedule Needs via Life Cycle System Planning

Decrease Inert Mass Vitrified

- Aluminum Dissolution
- Other Technologies

Mitigate Aluminum Limitation

- Batch Sequence Optimization
- Frit Development
- Revise RW Criteria / SR Glass Quals

Increase DWPF Throughput

- Equipment Modifications
- Facility Modifications
- Canister Modifications

Reduce Estimate Uncertainty

- Improved Characterization



Planned (High Temperature) Aluminum Dissolution Process

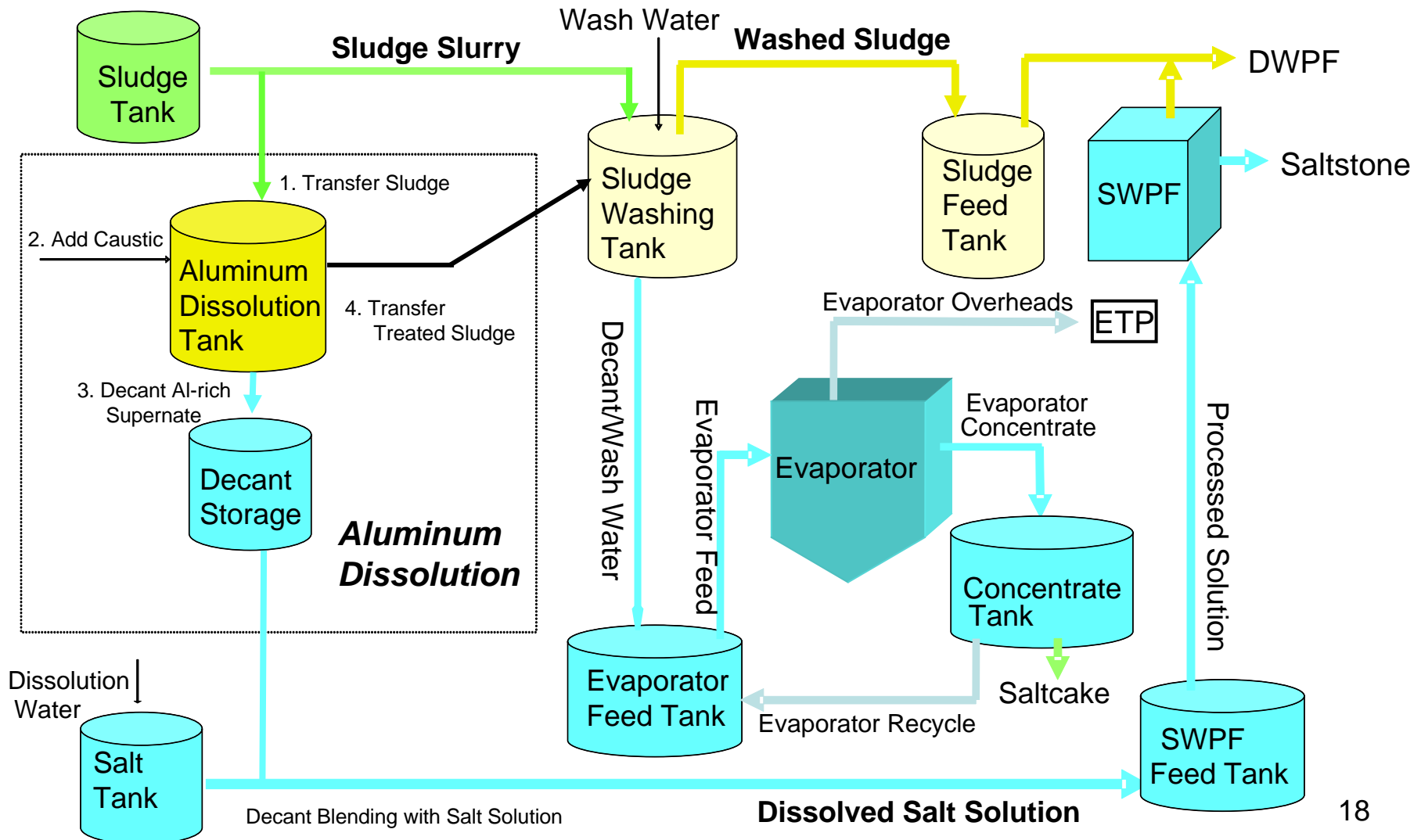
Six tanks contain over
1,000,000 kg aluminum
(61% of sludge total)

Final [OH ⁻]	3 M
Initial molar ratio OH ⁻ to Al	3
Temp	85°C
Time at temp	7 days
Removal	75%

SB	Al(OH) ₃ Removed (kg)
8	124,000
9	122,000
10	115,000
11	98,000
13	56,000
15	116,000
Total	approx. 632,000

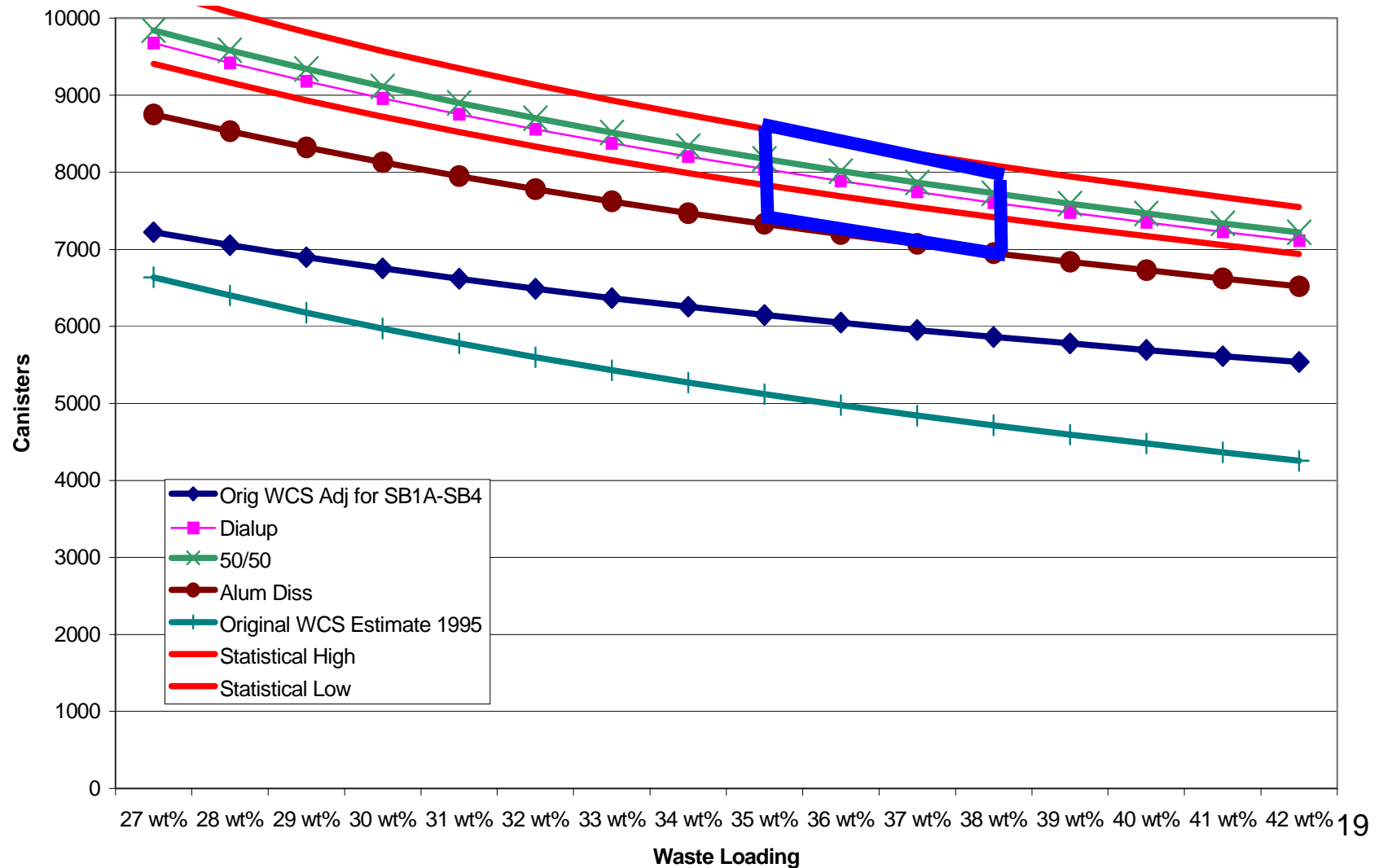
Saves about 1000 canisters of glass.
Decreases sludge batch processing time
by 6 years.

Aluminum Dissolution Process Integration



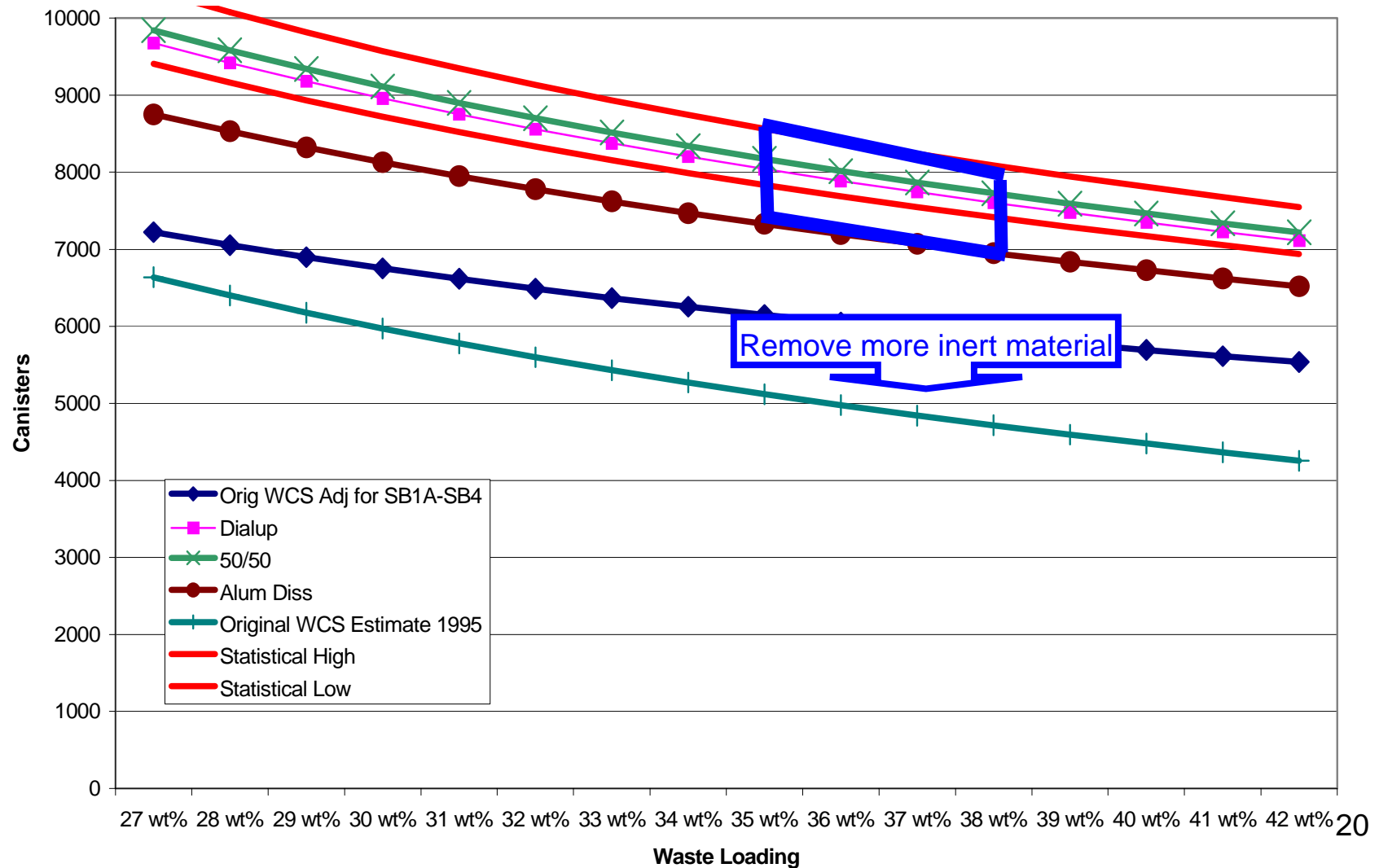
Total Canisters vs Waste Loading

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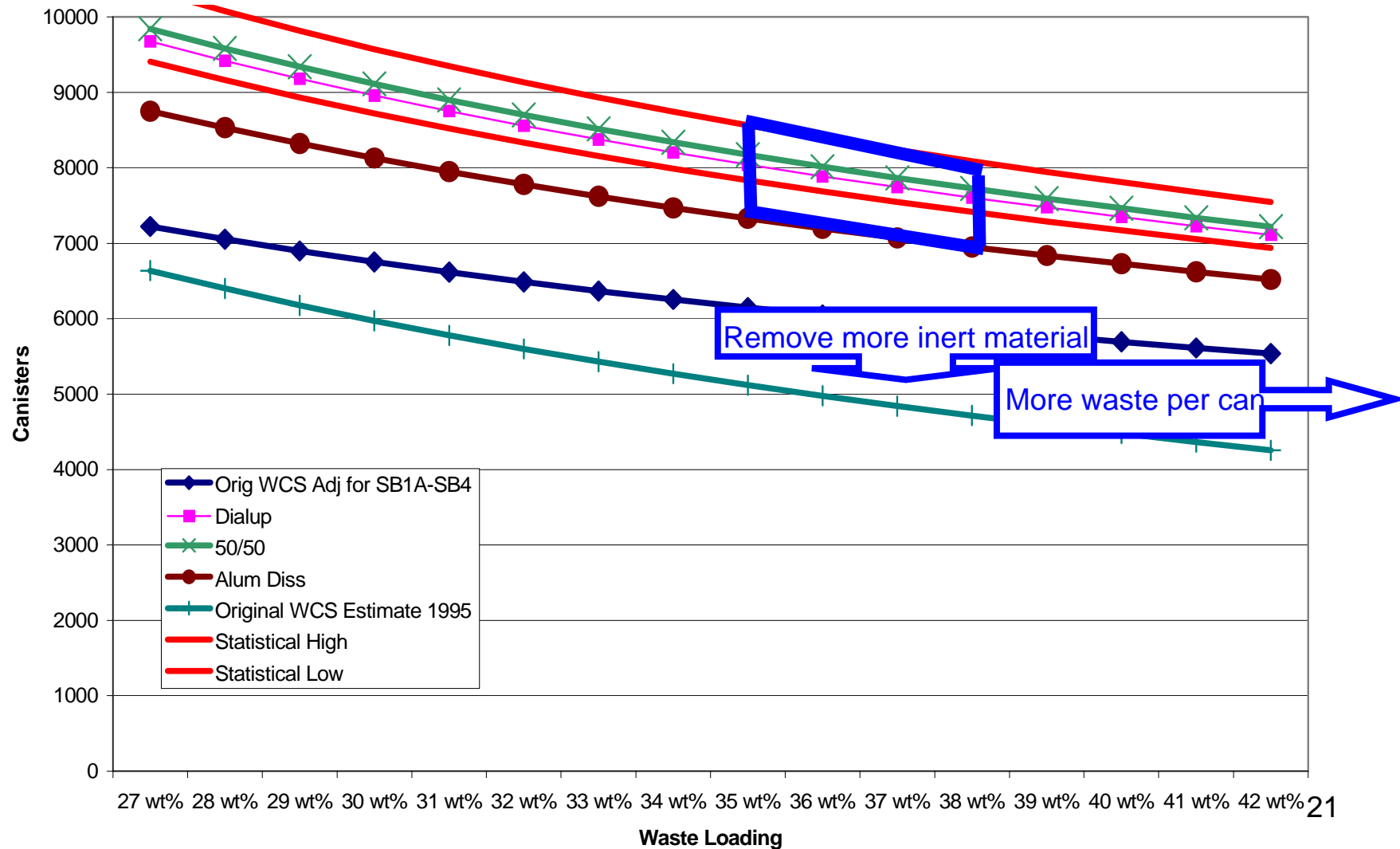
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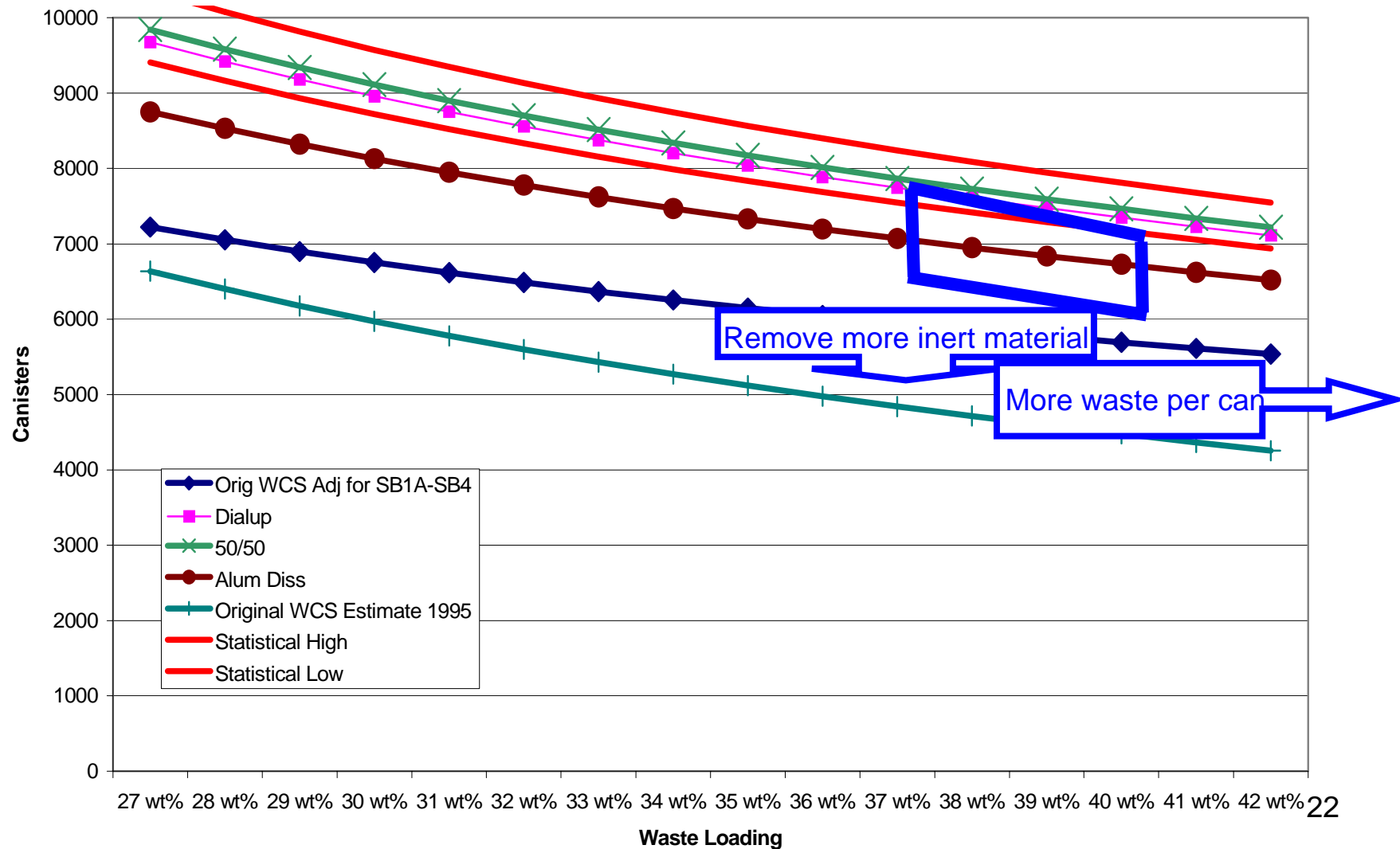
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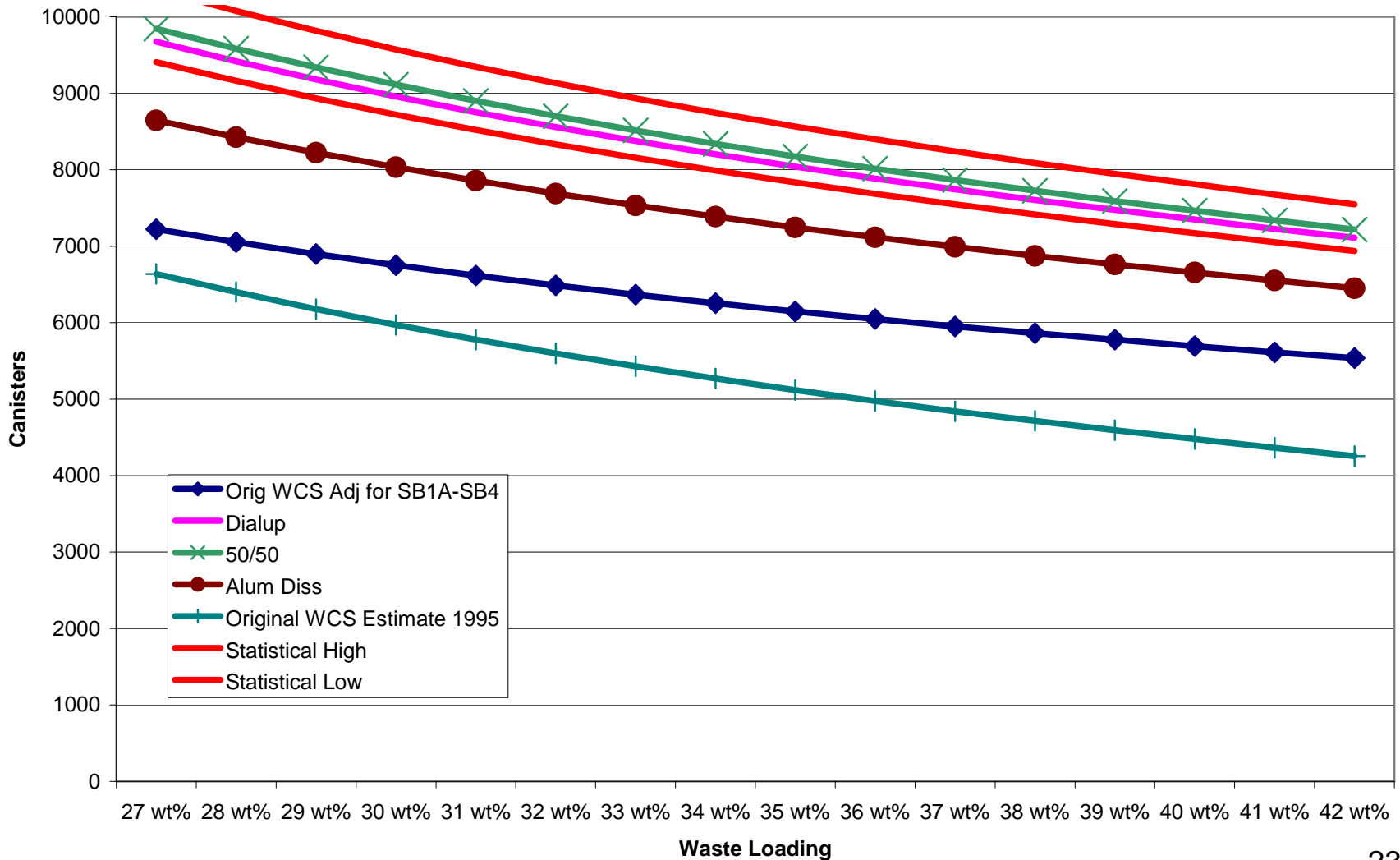
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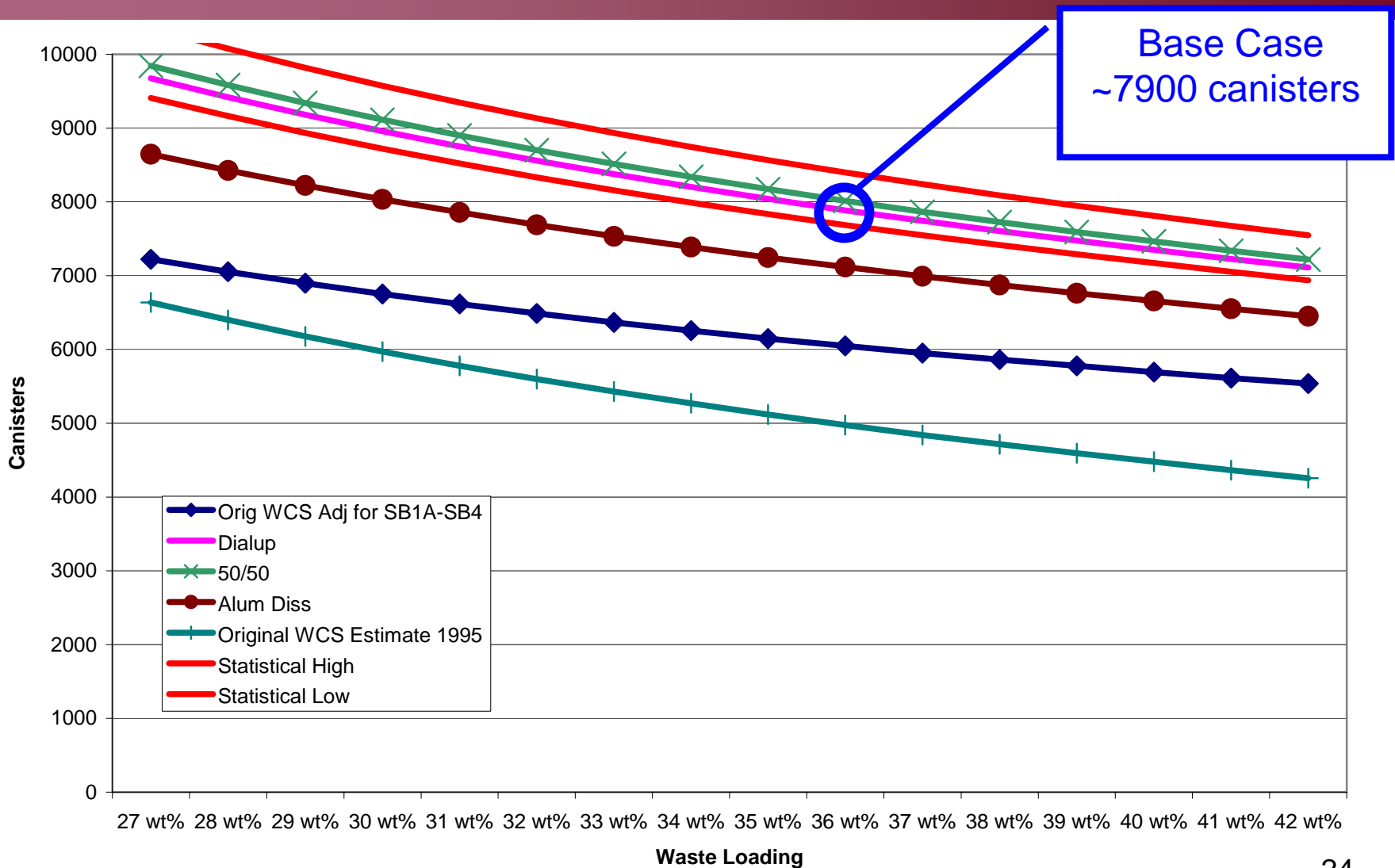
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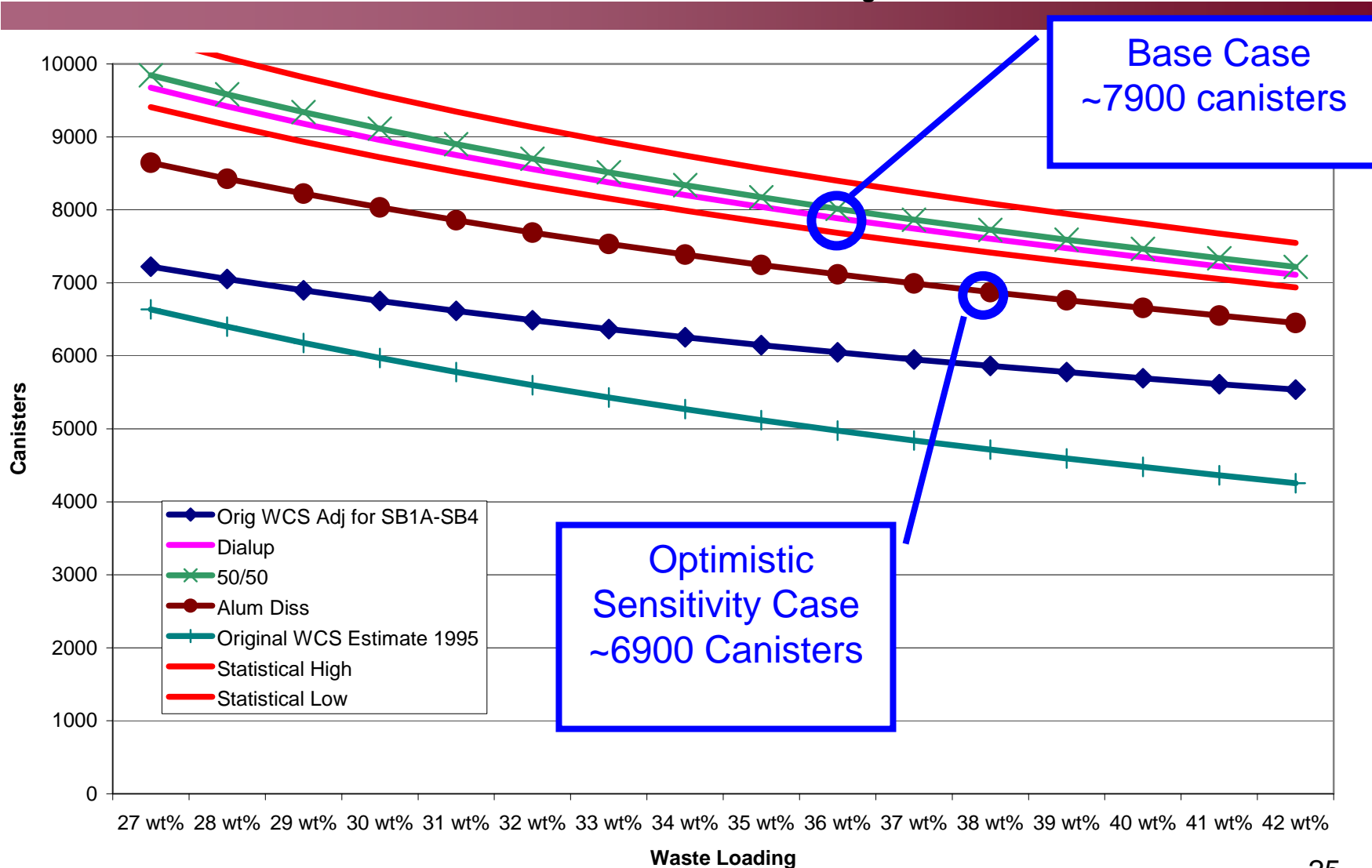
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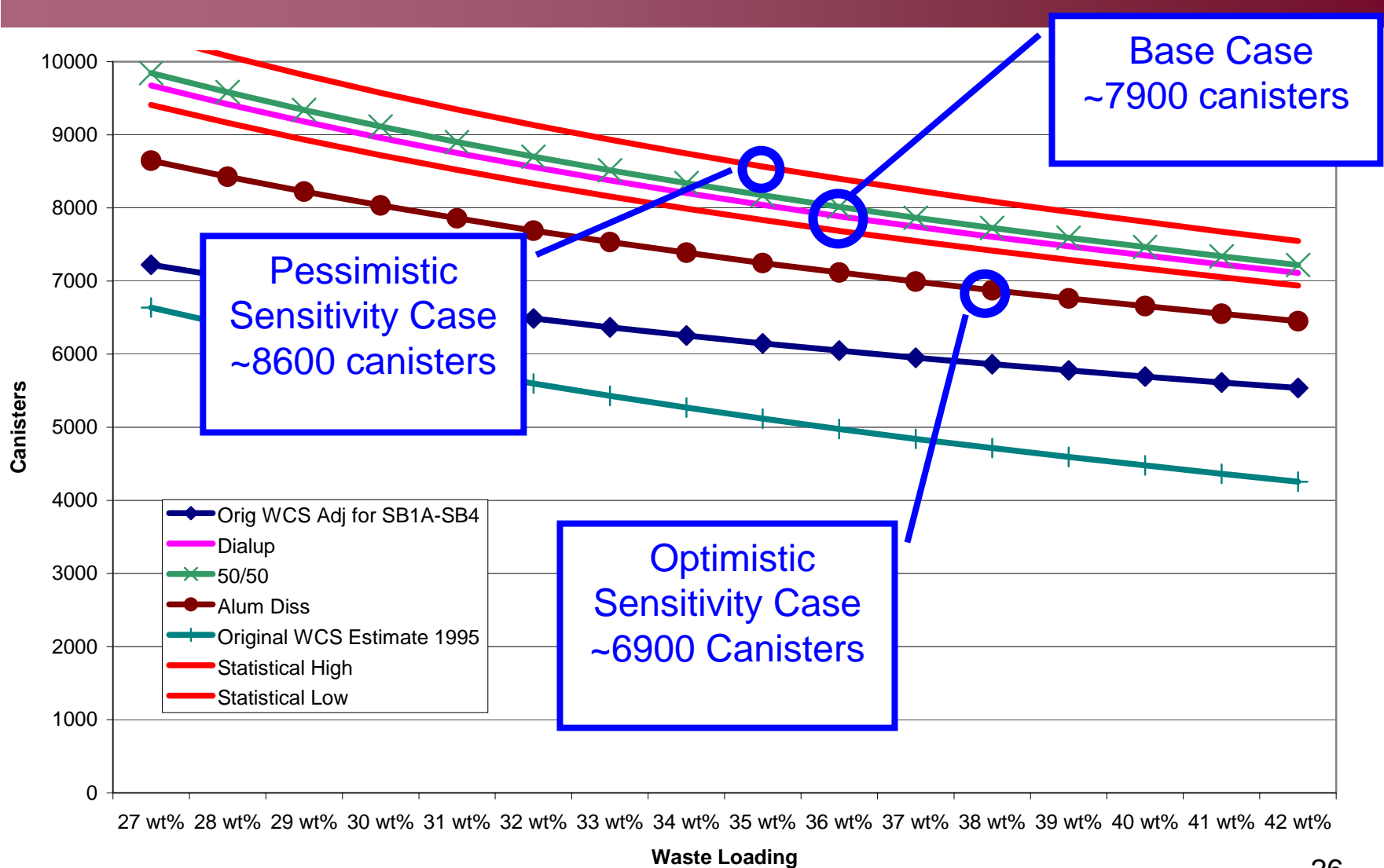
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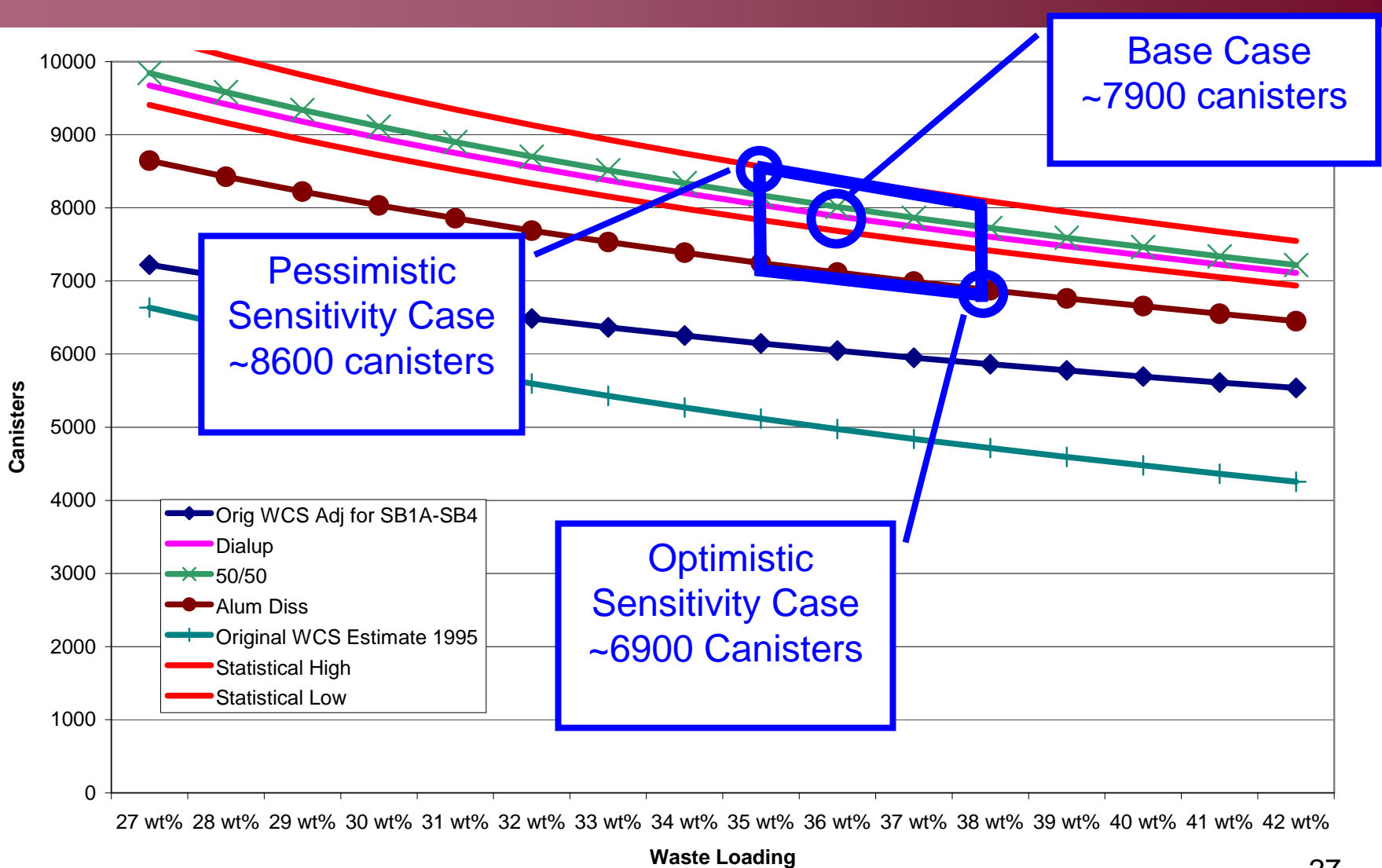
Total Canisters vs Waste Loading

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Total Canisters vs Waste Loading

Total Canisters vs Waste Loading



Low Temperature Aluminum Dissolution

- Sludge Mass Reduction Team searched for and evaluated other mass reduction methods.
- Low Temperature Aluminum Dissolution was identified for further evaluation.
- Project initiated early 2007

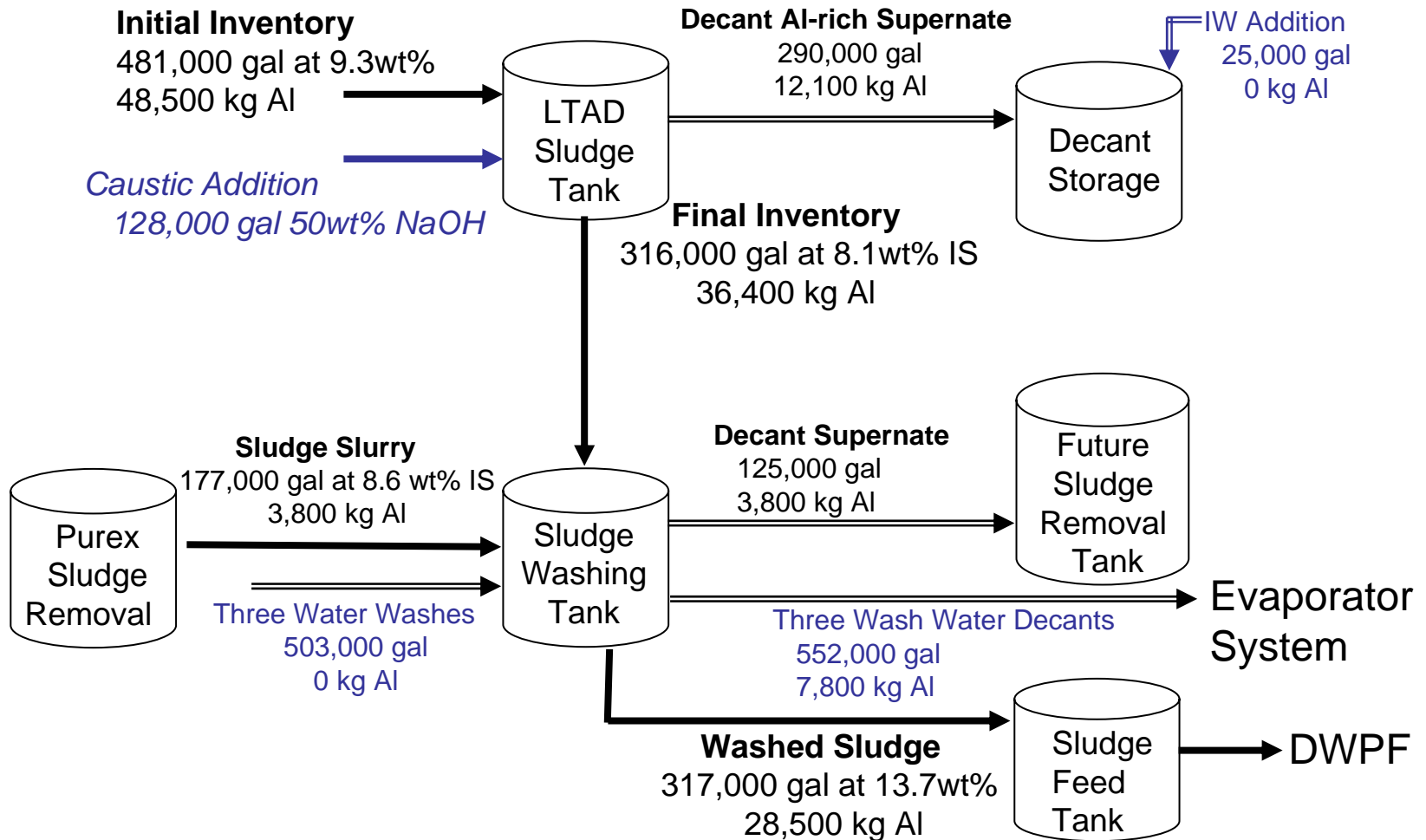
Projected DWPF Process Impact

Batch	Al in IS%	Cans	SOL%	Rate (cans/yr) @ 100% attainment	Rate (cans/yr) @ 85% attainment
SB3	7	720	37.5	265	225
SB4	12.3	390	35.2	232	197
SB5 w/o LTAD	19	576*	32.3*	190*	161*
SB5 w LTAD 60%	13	415*	34.9*	228*	194*

* projected based on change observed between SB3 and SB4

Low Temperature Aluminum Dissolution

Material Balance at 50% Removal



Planned (Low Temperature) Aluminum Dissolution Process

Six tanks contain over
1,000,000 kg aluminum
(61% of sludge total)

Final [OH ⁻]	3 M
Initial molar ratio OH ⁻ to Al	5
Temp	65°C
Time at temp	up to 21 days
Removal	50 to 60%

%	Al(OH) ₃ Removed (kg)
0	0
25	34,000
50	68,000
60	81,000
75	102,000
99	134,000

At 60%
Saves about 100 canisters of glass.
Decreases batch time by 12 months.

Questions?

Contact Information

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